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Potentially life-threatening vascular events (myocardial and cerebral infarction) - geographical distribution and temporal evolution in Romania

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Abstract

As worldwide, the non communicable diseases are a matter of concern in Romania, especially the cardio and cerebrovascular diseases that are the leading cause of death. The study of the geographical distribution and temporal evolution of these diseases could bring useful information for targeting cost-effective interventions that will avoid a great part of these deaths. The main objective of the study is to identify nationwide, regional and county-level the distribution of two types of life-threatening vascular diseases, myocardial and cerebral infarction and their temporal evolution. A cross-sectional study was conducted for period 2010-2014 by using validated hospital activity data reported at patient level by Romanian hospitals. The inclusion criteria considered all hospitals reporting data included in National Diagnosis Related Groups (DRG) database; data extraction targeted the selection of demographic and socioeconomic factors for DRG codes related to both health conditions. In the last 5 years the total number of potential life-threatening vascular events such as stroke and myocardial infarction increased, almost constantly the number of cerebrovascular events being several times higher than cardiovascular events. There are registred important differences among regions, the most affected being Bucharest area and several counties, both in myocardial and cerebral infarction. Men are almost twice affected by cardiac events, while in case of stroke there is a slight predominance for women in the last 2 years. Data indicates a constantly increasing predominance of patients residents in urban areas, the most affected being those over 65 and patients between 41-64 years of age. Further studies are required on the risk factors for these diseases in the most affected areas than targeted interventions should be designed and implemented in order to decrease morbidity and to prevent complications and loss of lives due to cardio and cerebrovascular diseases.

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Keywords: myocardial infarction, stroke, geographical distribution, time evolution, Romania

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1. Introduction

In a world of rapidly accelerating progress, non communicable diseases govern the model of morbidity and represent one of the most pressing public health concerns of the early millennium, affecting all countries and having a rapid growth. Non communicable diseases are the leading global causes of death. Their impact is particularly severe in low- and middle-income countries, more than 75% of cardiovascular deaths occur in these countries and 80% of all cardiovascular deaths are due to heart attacks and strokes [1], according to World Health Organization available data. A great part of these deaths could be avoided by well-understood, cost-effective and feasible interventions [2]. The leading causes of the non communicable diseases deaths in 2012 were cardiovascular diseases, with 17.5 million deaths, or 46% of all non communicable deaths. Of these deaths, an estimated 7.4 million were due to coronary heart disease and 6.7 million were due to stroke [3, 4]. Estimations showed that at global level by 2020 the ischemic heart disease will became one of the three leading causes of burden of disease [5], and the costs could rise by 22% by 2030 (from US$ 863 billion in 2010 to 1,044 billion in 2030) [6]. In response, in 2013, the 194 World Health Organisation Member States agreed on global mechanisms to reduce the avoidable non communicable burden including a "Global action plan for the prevention and control of non-communicable diseases 2013-2020" [7]. This plan aims to reduce the number of premature deaths from non communicable diseases by 25% by 2025 through nine voluntary global targets. Two of the global targets directly focus on preventing and controlling cardiovascular diseases.

In Romania, cardio and cerebrovascular diseases represents one of the most important public health issues, representing the leading cause of death (60% of all deaths). According to the *European Health for All Database* [8], the standardized death rate (SDR) for ischemic heart disease, all ages in Romania, in 2012 was 173.46 deaths per 100 000 population, which is more than double in comparison with the European Union (EU) average of 74.34 deaths per 100 000 population. The same is with the standardized death rate for cerebrovascular disease of 187.19 deaths per 100 000 population vs. 78.26 deaths per 100 000 population the EU average. Also, hospital discharge rate for cardiovascular diseases in 2012 in Romania (507.85/100 000) was more than twice the EU average (204.99/100 000). The first step in taking action towards the implementation of the WHO "Global action plan for the prevention and control of non communicable diseases 2013-2020" is to map and identify regional morbidity patterns, to investigate the causes and to implement disease prevention interventions. Therefore, the objective of this study was to investigate geographical patterns of the hospitalized morbidity by stroke and myocardial infarction, in Romania, given that there is not much evidence publicly available.

The objective of the study is to identify nationwide, regional and county-level the geographical distribution and the temporal evolution of two types of potentially life-threatening vascular diseases (myocardial and cerebral infarction).

2. Data and Metodology

A cross-sectional study was conducted to capture the scale of the potentially life-threatening vascular diseases phenomenon at national, regional, and local level. *The source of data* was represented by the National DRG (Diagnosis Related Groups) Database comprising hospital activity data reported at patient level, according to the Health Ministry's Order [9], no. 25/2012, approving the Validation Rules of the hospitalized cases under continuous hospitalization.

The inclusion criteria - all hospitals under contract with the National Health Insurance House and reporting monthly these data at the National School of Public Health, Management and Professional Development Bucharest were included in this study. *Data extraction* - the research used retrospective data for a period of five years range from 2010 to 2014. Data selection was made by using the SQL Server Management Studio Express 2005 software. There were considered the DRG codes corresponding to the two analysed health conditions: recent acute myocardial infarction (I21), respectively ischemic stroke (I63) meaning both thrombotic and embolic stroke. According to *Tabulated list of diseases, ICD-10-AM, Vol. 1 of international statistical classification of diseases and related health problems, overhaul 10 Australian modification (ICD-10-AM) Third Edition - July 1, 2002* [10], code I21 refers to acute myocardial infarction, including myocardial infarction specified as acute or with a term set for 4 weeks (28 days) or less from the onset, and I63 to cerebral and pre cerebral infarction, including brain artery stenosis and occlusion, resulting in cerebral infarction. Also there were considered sub codes for different localizations of acute

myocardial infarction namely acute trans mural myocardial infarction of anterior wall (I21.0), trans mural myocardial infarction of inferior wall (I21.1), acute trans mural myocardial infarction with other sites (I21.2), acute trans mural myocardial infarction with unspecified locations (I21.3), sub endocardium acute myocardial infarction (I21.4), acute myocardial infarction, unspecified (I21.9). Regarding stroke there were analysed only data on ischemic stroke, cerebral type thrombotic or embolic stroke. Data on haemorrhagic vascular events were not analysed. As in the case of acute myocardial infarction, there were analysed and used sub codes for cerebral infarctions located in different vascular anatomical regions, such as cerebral infarction due to thrombosis of pre cerebral arteries (I63.0), infarction due to embolism of pre cerebral arteries (I63.1), unspecified occlusion or stenosis of pre cerebral arteries (I63.2), cerebral infarction due to thrombosis of cerebral arteries (I63.3), cerebral infarction due to embolism of cerebral arteries (I63.4), cerebral infarction due to unspecified occlusion or stenosis of cerebral arteries (I63.5), cerebral infarction due to cerebral venous thrombosis, non pyogenic (I63.6), other cerebral infarction (I63.8), cerebral infarction, unspecified (I63.9). A study limit is the reporting accuracy, as some fields are constantly not properly filled by hospitals.

Methods - the descriptive analysis was focused especially on available demographic and socioeconomic factors found in literature or supposed to induce variability and inequities such as: gender, age, patient's residence, educational level and occupation. The data extracted and cleaned (only validated data remained) were analysed in a descriptive manner by using frequency and percentage tables. For a better visualization and identification of inequities, graphical illustrations completed the descriptive analysis. Data processing and analysis was performed by using MO Excel 2010 and SPSS 18 software.

3. Results

The main findings of this study are detailed hereinafter and they are organized by analysed items: demographic characteristics (gender, age) folowed by socioeconomic characteristics (residence, education level, occupation); the geographical distribution and temporal evolution of the indicators and the succession of the obtained results.

3.1. Geographical distribution and temporal evolution of the cases at national, regional and local level.

The hospitalized cases of acute myocardial ischemia at national level have a steady upward evolution during 2010-2014, from 12 631 cases in the first year of study to 15 138 cases in 2014. While there may be a slight decrease in 2014 compared to 2013, the increase by almost 22% in the past it's an important one. The analysis of the evolution of cases at regional level indicates significant differences, so if the largest amplitude of the phenomenon of myocardial infarction was recorded in the Northwest and Bucharest-Ilfov regions, at the opposite pole there are Southwest and West regions. There are important differences in the number of cases among regions, for example between the highest value observed in 2010, in Bucharest-Ilfov and the lowest value in the same year observed in Southwest, the difference is more than double. The same issue persists throughout the whole study period, with a slight decrease of the gap in 2014, when the difference between the highest number of cases in Northwest and the lowest number in Southwest is slightly lower than in 2010. Analysis at local level shows, that in 2014, the counties with the highest incidence of hospitalized acute myocardial infarction were found in the Northwest and Centre of the country, Bihor (BH), Cluj (CJ), Mureș (MS), Hunedoara (HD) counties were in the upper quartile, along with Dolj (DJ) county in Southwest and Constanța (CT) in Southeast (Figure 1).

In what regards stroke during 2010-2014 it is observed a much higher number of cases compared with acute myocardial infarction. For each year, the number of stroke events was 3-4 times the number of cardiac vascular events. Compared to 2010, when there were registered most cases, the trend is decreasing although it is a very slow decrease, the reduction observed in 2014 compared to 2010 being less than 5%. In terms of distribution of cases by region it is found that the highest number of cases was in the South, and the lowest number of cases was in the West region. There were at least two times more cases in the South region compared to West.

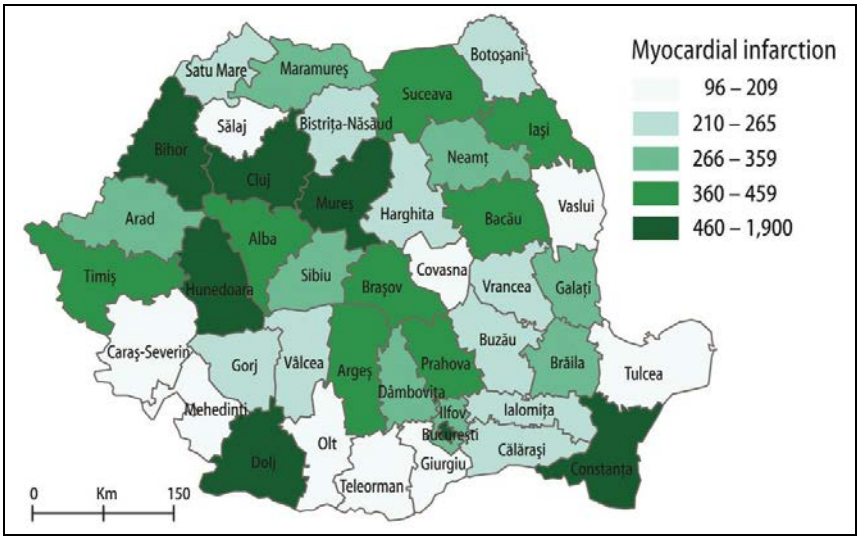

Fig. 1. Potentially fatal myocardial infarction events, in 2014, by county

The most significant reduction in the number of cases of stroke in 2014 compared to 2010 was recorded in the Northeast region, by almost 25%. There are also situations when compared to the 2010 in 2014 there is recorded an increase in the number of cases in regions such as Southwest and Northwest, with 20 and 10% respectively At county level, the distribution of hospitalized cases of cerebral infarction indicates a highest numbers of cases in South and Southwest, counties like Argeș (AG) and Prahova (PH), respectively Vâlcea (VL) and Gorj (GJ), and other counties are also placed in the highest interquartilic range, for example Mureș (MS) county in the Central region and Suceava (SV) and Bacău (BC) in the Northeast region (Figure 2).

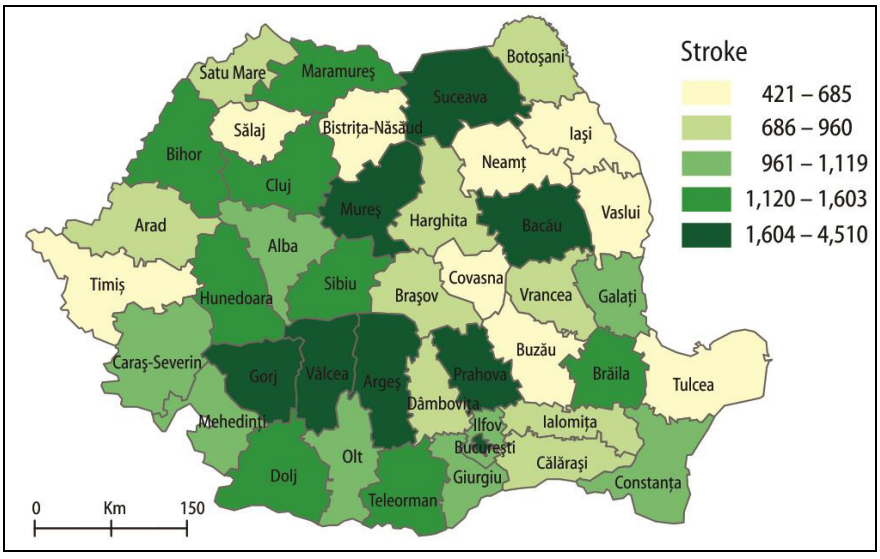

Fig. 2 Potentially fatal stroke events, in 2014, by county

3.2. The magnitude of the phenomenon represented by potentially life threatening vascular events (myocardialinfarction and stroke) at local and regional level

Regarding the magnitude of this phenomenon, both in terms of acute myocardial infarction and cerebral infarction, the maximum level in each of the five years of the study period was recorded in Bucharest-Ilfov region.
If in case of acute myocardial infarction in Bucharest-Ilfov after an initial regression in 2011 is found a growth in the year 2012, in the next two years occurs again a decrease in the number of patients with this condition, but the number recorded in 2014 is still higher than in 2010. Minimum in acute myocardial infarction cases was recorded in southwestern counties of the country (Olt county in 2010 and 2011 and Mehedinți - in 2012) and Southeast (Tulcea - in 2013 and 2014). For Olt and Tulcea situation remained unchanged for two years. Median string values appear in counties from different regions of Romania, South (Teleorman - 2010), Center (Sibiu - in 2011 and Alba - 2013), Northeast (Neamț - 2012) and Southeast (Brăila - 2014) (Figure 3).

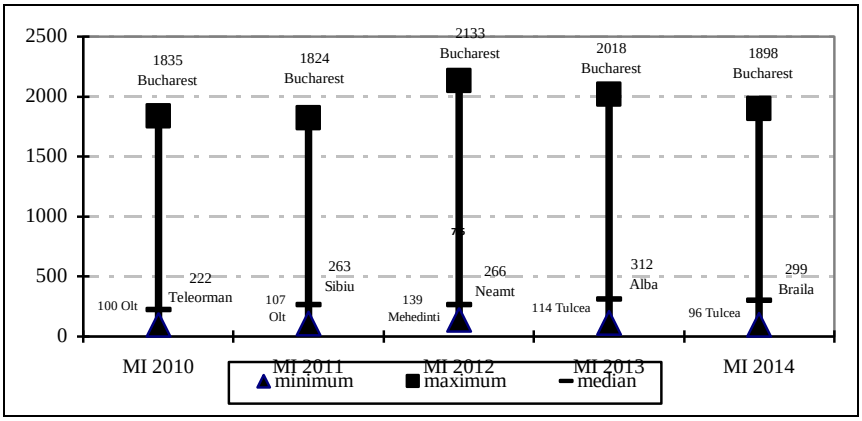

Fig. 3. Magnitude of myocardial infarction events, by county in 2010-2014

The situation as regards stroke in terms of magnitude of the phenomenon indicates the maintaining of a maximum number of cases in Bucharest-Ilfov region at a constant level of 4500-5000 cases throughout the period of the research, compared to values of hundreds of cases (between 200 and 400 cases), the minimum observed level in the counties as Tulcea in 2010, 2011, 2012 (South-East) Bistrița Năsăud 2013 (Northwest) and Vaslui in 2014 (Northeast). Median value occurred in counties in Southwest (Gorj in 2010 and 2011), Center (Sibiu - 2012 and Alba - 2014) and Southeast (Constanța - 2013) (Figure 4).

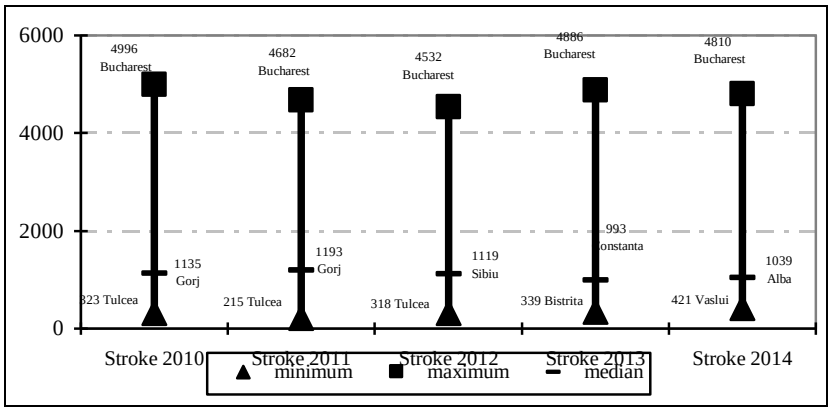

Fig. 4. Magnitude of stroke events, by county in 2010-2014

3.3. Distribution of cases represented by potentially life threatening vascular events (myocardial infarction and cerebral infarction) by gender and age, in 2010-2014

Analysis of potentially life threatening vascular events by gender reveals that men are more affected than women especially in case of acute myocardial infarction, and less for cerebral infarction. For all the years of study the number of male hospitalized with acute myocardial infarction was almost twice the number of women, and the trend was increasing, with a stagnation in the last two years for both genders (Figure 5a).

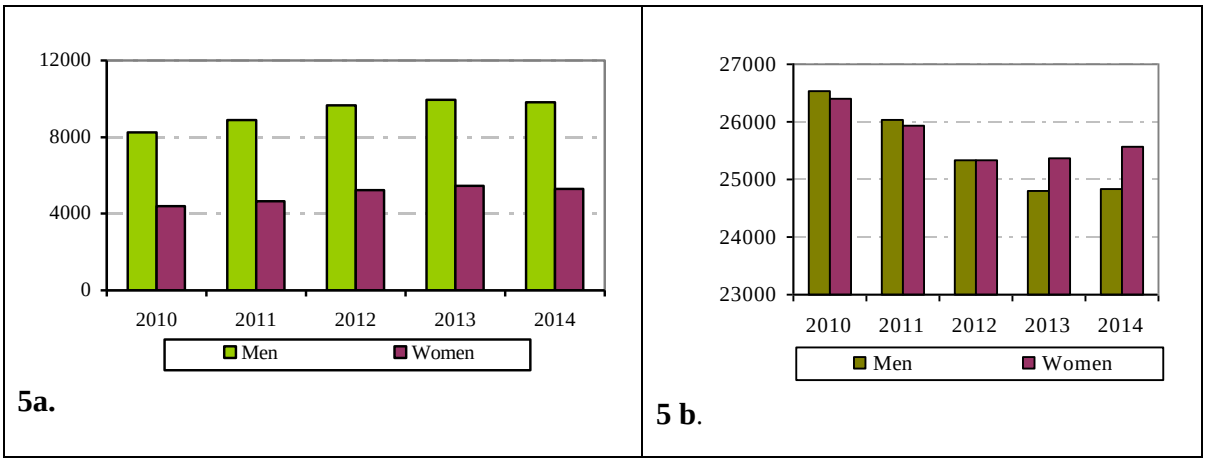

Fig. 5. Potentially fatal myocardial infarction events (5a) and fatal stroke events (5b) , by gender, 2010-2014

In the case of stroke, in 2010 and 2011 there were more cases in males, in 2012 the number of cases were similar for both genders, and begining with 2013 the number of women admitted with stroke predominated (Figure 5b). Yet gender differences for any of the years of study were not as important as in the case of myocardial infarction.

Analysis of cases by age group indicates a predominance of cases with acute vascular events in patients over 65 years. However, worryingly, particularly regarding acute myocardial infarction is the increase of number of cases is younger ages (41-64 years) from 5605 cases in 2010 to 6373 cases in 2014. Hundreds of cases were registered in people under 40 years of age, with an increasing trend, reaching 430 cases in 2014. Cerebral infarction during the study recorded the highest number of cases in the elderly, the trend being constant. In younger people (41-64 years), these events occured with a frequency of approximately 2 to 2.8 times lower, and there is a slowly decreasing trend from 16 052 in 2010 to 13 128 in 2014. Under 40 years the number of cases decreased from 501 in 2010 to 10 in 2014.

3.4. Distribution of cases represented by potentially life threatening vascular events (myocardial infarction and cerebral infarction) by area of residence, in 2010-2014

Most of the patients addmitted with acute myocardial infarction within the study period were from urban areas, the number of these patients being nearly twice the patients residing in rural areas. The trend has been increasing over the studied period for patients from both residence areas (Figure 6a).

Regarding cerebrovascular events, the recorded cases were more numerous than those of myocardial infarction (average 3-4 times higher) for patients in both residence areas. Unlike the previous situation, patients from urban areas more frequently presented cerebral infarction than those in rural areas only in the first three years of the study. For the years 2013 and 2014 the situation was similar, in terms of patient residence. Overall, while in urban areas along the studied period it was a decreasing trend in the number of cases of stroke, in rural areas the situation was stationary (Figure 6b).

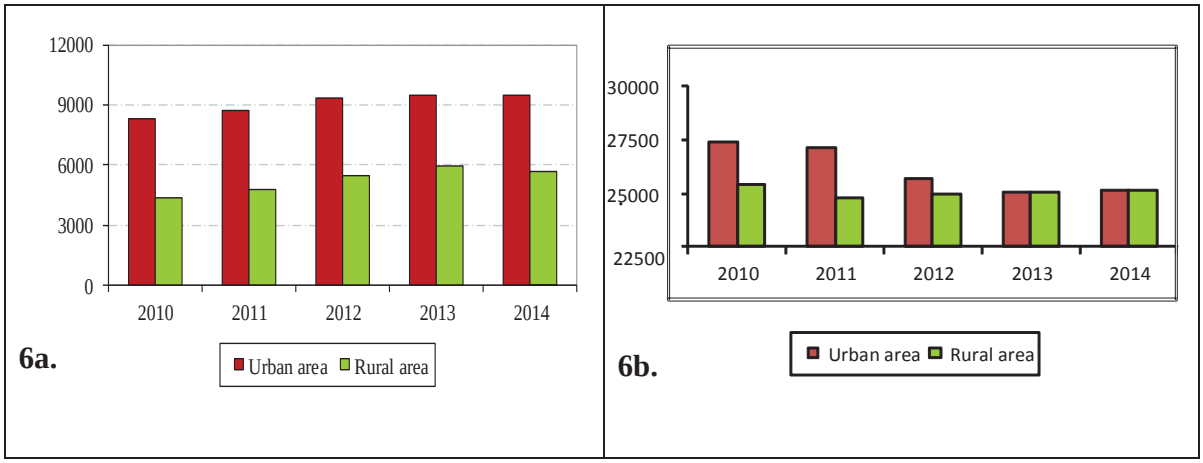

Fig. 6. Potentially fatal myocardial infarction(6a) and fatal stroke events (6b), by patient's residence, 2010-2014

3.5. Distribution of cases represented by potentially life threatening vascular events (myocardial infarction and cerebral infarction), by level of education, in 2010-2014

The most of the patients admitted with myocardial infarction and with cerebral infarctionhad low educational levels (primary or secondary graduates, patients with vocational school). Among myocardial infarction cases there were about 3 times more patients with lower educational level, compared to patients with higher educational level (high school, college, university), and in the case of stroke patients with low education level were on average 1.5 times more than the patients with higher education levels (Figure 7). Analysis of cases was performed only for patients for whom the education level was filled in the hospital patient record.

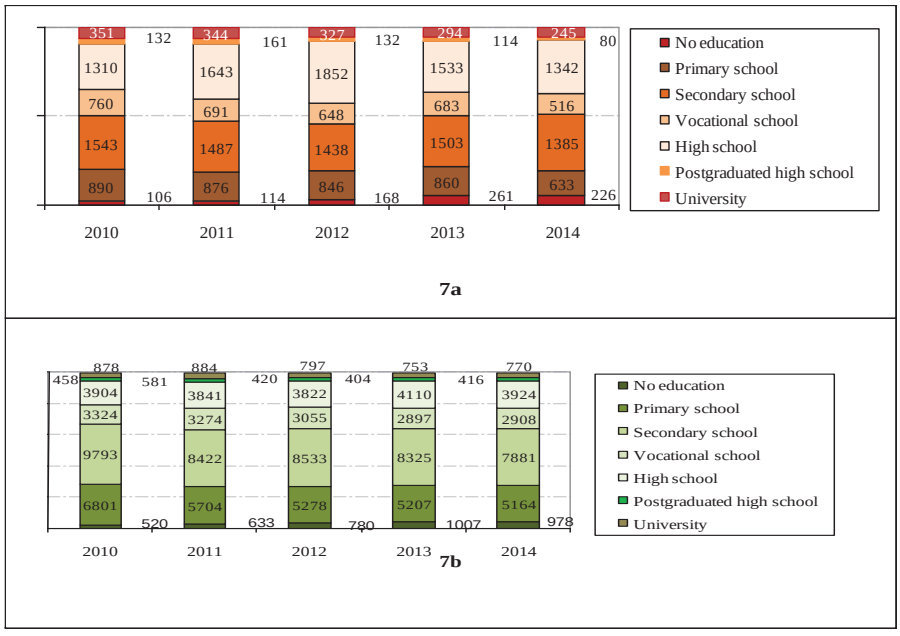

Fig.7a,b.. Potentially fatal myocardial infarction(7a) and fatal stroke events(7b) by patient's level of education, 2010-2014

3.6. Cases distribution representing vascular events, potentially life threatening (myocardial infarction and cerebral infarction), depending on patient's occupation, in 2010-2014

Regarding occupation of patients hospitalized for acute vascular events, most of them were pensioners, employees and people with no occupation. Acute myocardial infarction affected about 4 times more pensioners than employees (Figure 8). The number of stroke cases in pensioners exceeded the number of cases among employees approximately 13 times, (Figure9). Unemployed were affected more frequently by stroke compared with myocardial infarction. Analysis of cases was performed only for patients for whom the corresponding field was filled in the patient hospital medical record.

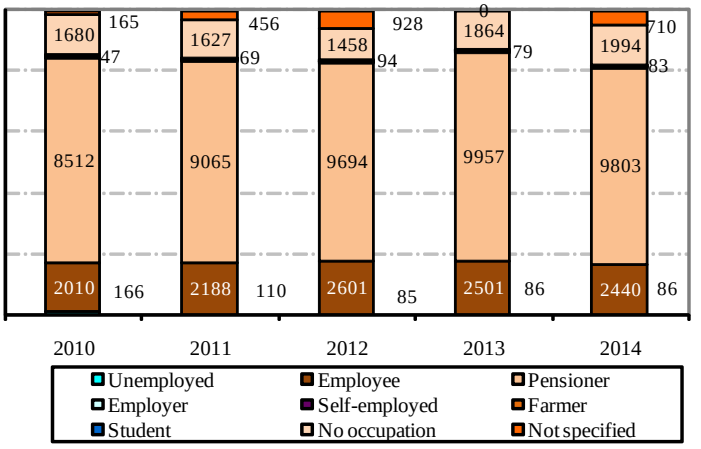

Fig. 8. Potentially fatal myocardial infarction events, by patient's occupation, 2010-2014

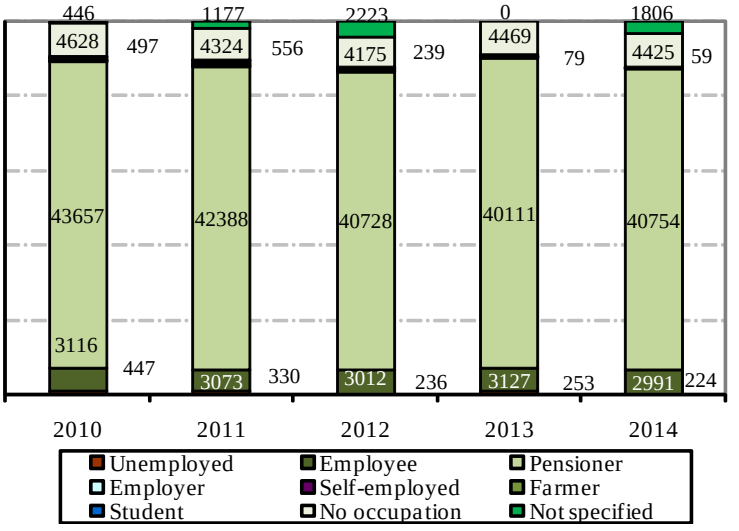

Fig. 9. Potentially fatal stroke events, by patient's occupation, 2010-2014

5. Conclusions and discussions

In Romania there are important inequalities in health regarding cardiac and cerebral vascular events, with differences in their incidence and temporal trend, but also geographical differences between regions and counties in Romania, respectively in patient's gender, age, residence, education level and occupation. During 2010-2014, hospitalised cerebrovascular pathology was more frequent than heart vascular pathology. While the stroke had a slight decreasing trend, the trend for hearth vascular pathology was increasing. In both pathologies, important differences between country regions were found:

- for heart disease the most affected counties were located in the West and Centre of the country,
- for cerebrovascular diseases the most affected counties were in the South and Southwest.

As the literature suggests, some of the possible causes of this situation may be related to behavioural, educational [11, 12] and cultural differences [11], but also differences among organization and functioning of health services [11] and emergency services. All these factors and maybe others as well, should be further investigated in order to reveal the specific causes for Romania. By assuring an efficient and equitable allocation of resources, some deprived areas could be equipped with basic resources in order to assure a functional system allowing early and specific actions that are important for stroke and heart attack intervention. Interventions must be included in an efficient case management plan and must target measures ranged from preventive (primary health facilities – early detection by monitoring risk factors) to treatment (emergency and hospital specific – early action) and to rehabilitation [11].

The current study reveals that myocardial pathology in men is almost two times more frequent than in women, almost similar to a study from Finland, during 2000-2009 [13, 14], possibly as a result of the risk factors more present in men than women (i.e. smoking, alcohol consumption) but the trend is increasing for both genders. Cerebral pathology affects both genders in roughly equal proportion with a slight predominance of women in the last two years. Other study carried out in 2008 in Romania showed a slight predominance of men affected by stroke, the same situation as in the current study for year 2010 and 2011 [15]. Usually, stroke and myocardial infarction appear in the presence of a combination of risk factors, such as tobacco use, unhealthy diet and obesity, physical inactivity and harmful use of alcohol, hypertension, diabetes and hyperlipidaemia [4]. As the main determinants of heart attacks and strokes can be reduced by behavioural and life style changes, a lot of benefits would be achieved.

Patients living in urban areas are more affected by both types of pathology, possibly due to the differences regarding risk factors between the two residence areas such as: unhealthy diet [16] resulting in nutritional deficiency [17, 18, 19], cities pollution by environmental pollutants [20] and traffic pollution [11] and daily psychological stress [11], as shown by other studies. Urbanization is one of the underlying determinants of chronic diseases according to World Health Organisation [16]. The age group most affected is 65 years and older, the tendency is upward for both pathologies, but a large number of cases appear at younger ages, 41-64, and even 20-40 years old, especially for myocardial infarction. Ageing population represents another underlying determinants of chronic disease [16], so our findings regarding the high frequency of vascular events in the elderly people are correlated with international figures, but the relatively high frequency in younger ages is the most worrying fact.

People with less education (primary and secondary school and vocational school) are predominant in our findings, what could be a signal for including health education programmes in school and/or in community, given that is known it is better to prevent than cure. As other studies shown, the level of education makes part of social determinants of health having influence also on cardio and cerebrovascular health [11, 12] and as demonstrated low-cost educational programs can have an impact on decreasing cardio and cerebrovascular risk factors [21]. In both types of pathology the most representative social category is the pensioners, being followed by the employees and the unemployed. Unemployment it is supposed to have effect on cardiovascular disease [11] and risk factor [22] with negative repercussion on health, but also this role is questioned by other studies [23].

In conclusion, some general perspectives are emerging from our study findings and should be underlined. In the context of study results, a better knowledge of the situation at national and local level regarding these types of conditions is needed. Taking into account the scale and gravity of the problem and in order to develop specific public health strategies, it is necessary as future directions of action to complete current evidence with further in-depth research targeting the areas and populations at risk identified by this study. As long-term action, periodical evaluations should be part of a specific monitoring programme capable to provide decision makers with scientific evidence and allowing time-effective interventions so many fatal cases due to these events can be prevented through an improved management of stroke and myocardial infarction, both at patient and health system level.

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